SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

Be it known that I, THOMAS SCHMIDT, a citizen of Germany, resident of Kandel, Germany, have invented a new and useful improvement in a

WET CLUTCH OR FRICTION PLATE BRAKE

which invention is fully set forth in the following specification.

WET CLUTCH OR FRICTION PLATE BRAKE

BACKGROUND OF THE INVENTION

The invention concerns a wet clutch or a friction plate brake according to the pre-characterizing portion of Claim 1.

In this field a generic wet clutch or friction plate brake is generally comprised of a clutch housing, a clutch hub, various outer and inner friction plates, an apply piston and an apply piston support device for carrying the apply piston. All the above-mentioned construction components are as a rule formed essentially rotation-symmetrically and are provided coaxially about a common (rotation) axis.

The clutch housing is essentially in the form of a hollow cylinder and is mounted rotatably about the rotation axis. It carries one or more outer friction plates, wherein these are essentially displaceable or slideable in the axial direction.

In similar manner the clutch hub is also essentially in the form of a hollow cylinder and is mounted rotatably about the same rotation axis. This also carries one or more preferably ring-shaped inner friction plates which are displaceable essentially in the axial direction.

Outer friction plates and inner friction plates alternate in the axial direction, thereby forming so-called friction pack. Thereby one of the contact surfaces of an outer friction plate is arranged for contacting one of the contact surfaces of one inner friction plate, so that these can be brought into frictional contact by pressing against each other. The outer or the inner friction plates carry a friction lining.

The friction pack is closed off on one end in the axial direction by an apply plate, which could represent either one of the friction plates carried on the clutch housing or one of the friction plates carried on the clutch hub. In the axial direction on the other side of the friction pack there is an end plate which is basically not slideable in the axial direction. This end plate represents one of the friction plates carried on the clutch housing or one of the friction plates carried on the clutch hub.

In order to bring the broad faces of adjacent outer and inner friction plates into frictional contact with each other in the above-described manner, there is provided in accordance with the state of the art a so-called apply piston. An apply piston of this type is formed in the manner of a hollow cylinder or pot. The outer rim of the sidewall of the pot forms a ring-shaped pressure unit, which can be pressed against the free broad surface of the above-described apply plate. In this engaged or pressed-in condition, torque can be transmitted from the clutch housing onto the clutch hub, or the reverse.

In order to be able to operate this actuation piston it is necessary on the one hand that this is mounted in suitable manner to be axially slideable, and on the other hand that it can transmit a pressure force.

According to the state of the art, for transmission of the pressure force an apply piston support device is provided which is rigidly connected with the clutch hub or clutch housing by means of a suitable connecting device. This actuation piston support device is essentially in the form of a hollow cylinder and is provided coaxially and preferably radially interiorly to the clutch hub. The apply piston support device includes an essentially ring shaped piston support plate or plate, against which or upon which on one side, which in the following will be referred to as the piston support plate inner surface, the apply piston is supported for axially transmitting pressure force.

In this device, a ring-shaped hollow space is enclosed by the piston support plate inner surface, against which the apply piston supports itself, in combination with the cylindrically shaped support surface of the apply piston support device, plus the piston support outer surface of the apply piston by means of which the apply piston is supported on the piston support plate inner surface. In this hollow space, which in the following will be referred to as the apply piston space, there is situated oil, as in the entire inner space of the wet clutch.

If the clutch device is then set into rotational movement (so-called rotating clutch actuation), with increasing speed of rotation, oil tends to flow

in this apply piston space due to centrifugal force and at the same time there is an associated increase in pressure. This pressure increase causes the apply piston to press in the axial direction against the friction pack. It is then necessary to employ suitable means to compensate for this parasitic force induced by centrifugal force.

According to the state of the art basically two possibilities are known for compensating for centrifugal force. On the one hand centrifugal force is compensated by a "check ball".

This means need not be discussed in greater detail in the following. It is further known in accordance with the state of the art to employ a so-called balance or balance piston. A balance piston of this type is based upon the idea of providing, in the apply piston space lying opposite the side of the apply piston, a space filled with oil in which a counter pressure is produced due to centrifugal force. In practical terms this is realized in accordance with the state of the art in the below described mode and manner.

One such balance piston according to the state of the art is essentially in the shape of a hollow cylinder, including a ring shaped floor and a cylindrical wall. This balance piston is provided coaxially to the clutch hub and is essentially fixed in axial direction with the apply piston support device. According to the state of the art the outer wall of the cylinder is provided coaxial and radially interior to the apply piston support device, while the walls of the hollow cylindrically shaped apply piston support device as well as those of the balance piston at their base or floor surfaces are oriented opposing each other in the axial direction.

The apply piston exhibits in the coaxial arrangement a ring shaped wall, of which the outer surface is guided slideably essentially in the axial direction on the inner surface of the cylindrical wall of the apply piston support device and of which the inner surface is guided slideably essentially in the axial direction on the outer surface of the essentially cylindrically shaped wall of the balance piston. By this particular arrangement of

balance piston and apply piston to each other a hollow shape is formed, which represents the above discussed equalizing space.

Although an arrangement of this type has essentially proven itself as useful, with this type of arrangement a complete compensation of centrifugal forces is only possible at great expense. Usually, return spring devices are used. Further, attempts have been made to conform the axial lengths and stroke paths of apply piston support devices, apply pistons comprised of one or more parts, and balance pistons. Through the use of further supplemental construction components, finally a complete compensation is achieved. The realization of complete compensation however requires a substantial construction investment.

It has been found, that an optimization of this type is not possible in a compact construction. Until now a compensation of approximately 80% has been achieved herein.

The invention is thus concerned with the task of designing and further developing a wet clutch system transmission according to the state of the art or a double clutch transmission, such that the above-described problems no longer occur. In particular, a complete compensation for centrifugal force is to be made possible with compact construction.

This task is inventively solved by a wet clutch system having the features of the characterizing portion of Claim 1.

Advantageous embodiments and further developments of the invention are set forth in the dependent claims.

The essential concept of the invention is comprised therein, that the contacting surfaces of the balance piston and the apply piston are no longer provided as in the state of the art coaxial and with radial separation within the apply piston support device, but rather that the corresponding contact surfaces for the balance piston and apply piston are provided coaxial between the corresponding cylinder shaped walls of the clutch hub and the apply piston support device. By this means it is achieved that the oil-wetted surfaces of the apply piston enclosed by the balance piston are significantly enlargened.

It has been found that a device of this type brings with it a further advantage. Details will be discussed in the following:

By the engaging arrangement of the clutch hub, the balance piston and the apply piston which is supported on the apply piston support device a space is enclosed thereby, which in the following will be referred to as the oil-space. In this oil space there is provided a certain amount of oil.

In an automatic transmission with a wet clutch it is necessary, in order to remove produced frictional energy, to direct a part of this oil situated in the oil space to the friction pack in the form of an oil flow. Since the oil situated in the oil space is, in any case, caused by centrifugal force to be flung against the inner wall of the clutch hub, this arrangement requires only appropriate oil supply channels or the like, which are provided in the inner wall of the clutch hub, to be guided to the individual friction plates.

If the balance piston is designed and positioned in accordance with the invention, then the volume of the oil space in the area of the inner wall of the clutch hub is reduced. Thereby a supplemental positive or forced oil flow occurs, which further supports the oil transport to the friction plates of the friction pack.

For increasing the stiffness and therewith providing an improvement of the hydraulic-mechanical ability of the total system to react it is optionally provided that the balance piston exhibits at least one contact point or position, at which this is connected to the clutch hub. It is inventively envisioned that at least one contact point is provided between the balance piston and the clutch hub at the floor plate of the balance piston. Alternatively or supplementally a contact point is provided on the outer surface of the cylinder wall of the balance piston.

As has already been described above in detail, it is necessary in automatic transmissions with wet clutches for removal of produced frictional energy, to direct a targeted oil stream to the friction pack. From the state of the art it is known to provide on the side of the clutch hub facing the apply piston a radially inwardly facing oil collecting ring. An oil collecting ring of this type is disclosed for example in the text book "Automatic Vehicle

Transmissions" from Hans Joachim Foerster, 1990, ISBN 3-540-52228-X on page 285, Figure A or page 286 Figure A, element E. A fluid ring of oil is produced by this oil collecting ring on the inner side of the clutch hub, which is supplied by oil flung out of the oil space. Thereby oil is comparatively efficiently channeled through the above described oil channels or the like in the clutch hub to the friction plates of the friction pack. A greater oil volume is channeled bypassing the clutch as overflow.

It has further been found to be of advantage, when at least one of the above mentioned contact points between the balance piston and the clutch hub is situated at the inward facing oil collecting ring. In this manner a positive or forced guidance is formed immediately directly on the above-mentioned oil supply channels or the like in the clutch hub. An escape or evasion of a larger oil volume is no longer possible.

For guaranteeing a sufficient oil transport there is provided in accordance with the invention, in the case that the above discussed connecting devices are formed in the manner of a hollow cylinder, a common oil supply in the hollow cylinder for the equalizing space and the oil space. It is however possible in accordance with the invention that separate oil supplies are provided for the equalizing space and the oil space.

An illustrative embodiment of the invention is shown in the figure and will be described in greater detail in the following.

There is shown:

Fig. 1a an axial sectional representation of a wet clutch according to the invention,

Fig. 1b an axial sectional representation of the wet clutch according to Fig. 1a with illustration of the hollow space in which oil is situated, namely apply piston space, equalizing space and oil space,

Fig. 1c the spatial pressure distribution of the oil in piston space according to Fig. 1b,

Fig. 1d the spatial pressure distribution of the oil in equalizing space according to Fig. 1b,

Fig. 2a an axial sectional representation of a wet clutch according to the state of the art,

Fig. 2b an axial sectional representation of the wet clutch according to Fig. 2a with illustration of the hollow space, in which oil is situated, namely actuating space, equalizing space (counter equalizing space) and cooling oil space,

Fig. 2c the spatial pressure distribution of the oil in piston space according to Fig. 2b, and

Fig. 2d the spatial pressure distribution of the oil in equalizing space according to Fig. 2b.

The subject matter of the invention will be described below on the basis of a side-by-side comparison of a wet clutch of an automatic transmission according to the state of the art as shown in Fig. 2 and a wet clutch of an automatic transmission according to the invention as represented in Fig. 1. It should however be noted that the invention is concerned in general with force transmission aggregates of the type which employ for force transmission a friction pack with multiple friction plates (at least two friction plates), which intermesh or interdigitate in manner of gear teeth, wherein respectively adjacent friction plates can be brought into frictional contact with each other by means of a suitable actuating device.

As can be seen from illustration Fig. 2a, a wet clutch **200** of an automatic transmission is comprised of a clutch housing **21** mounted rotatably about a rotation axis R, essentially in the shape of a hollow cylinder, as well as a clutch hub **22** provided at least partially coaxially to the clutch housing **21**, mounted rotatably about the rotation axis R and likewise essentially in the shape of a hollow cylinder, and an apply piston support device **32** essentially in the shape of a hollow cylinder provided radially inwardly and coaxial to the clutch hub **22,** and further, an apply piston **28**, an balance piston **34** as well as an essentially hollow cylinder shaped connecting device **40** which rigidly connects the clutch hub **22**, the balance piston **34** and the apply piston support device **32** to each other.

Outer and clutch hubs **21, 22** enclose a so-called friction pack **23**, of which the individual components and the manner of operation will be described in greater detail in the following. The friction pack **23** illustrated in Fig. 2a is essentially comprised of four components, namely a so-called apply plate **24**, a generally large number of steel core plates **25.1, 25.2** and **25.3** and friction plates **27.1** and **27.2** as well as a so-called end plate **26**. All components - apply plate **24,** steel core friction plates **25.1, 25.2, 25.3**, friction plates **27.1, 27.2** and end plate **26** - are provided essentially rotation symmetrically. They have preferably planar and preferably ring shaped contact surfaces. The surface area of the contact surfaces is as a rule large in comparison to the thickness of the friction plates **25.1, 25.2, 25.3**, **27.1, 27.2**.

It can further be seen from Fig. 2.1, representing the state of the art, that the apply plate **24** as well as the end plate **26** and the friction plates **27.1, 27.2**, are provided with friction linings **24a, 26b, 27.1a, 27.1b, 27.2a** and **27.2b**. While the apply plate **24** and the end plate **26** respectively exhibit only one friction lining **24a** and **26b,** the friction plates **27.1** and **27.2** in this illustrative embodiment are provided on both sides with friction linings **27.1a, 27.1b** as well as **27.2a** and **27.2b**.

It is readily apparent that other arrangements can be provided such as outer friction plates and inner steel friction plates or so-called single-side

friction plate arrangements, which include alternating inner and outer friction plates provided on one side with a friction lining.

The individual friction plates **25.1, 25.2, 25.3, 27.1** and **27.2** as well as the apply plate **24** and the end plate **26** are provided in such a manner, that the respective friction linings **24a, 26b, 27.1a, 27.1b, 27.2a** and **27.2b** of contact surfaces of apply plate **24**, end plate **26** and the friction plates **27.1** and **27.2** are provided adjacent to the respective friction-lining-free contact surfaces of the steel core friction plates **25.1, 25.2** and **25.3**. In concrete terms this means an arrangement in axial direction in the following sequence: apply plate **24**, steel plate **25.1**, friction plate **27.1**, steel plate **25.2**, friction plate **27.2**, steel plate **25.3** and end plate **26**.

The apply plate **24**, the end plate **26** as well as the friction plates **27.1** and **27.2** are connected in the radial direction essentially fixed against rotation with the so-called clutch hub **22**. In analogous manner there results in radial direction an operative connection or association between the clutch housing **21** and the steel plates **25.1, 25.2** and **25.3**. For achieving a connection of this type between the carriers **21** and **22** and the friction plates **25.1, 25.2, 25.3** and **27.1** and **27.2, 24, 26**, these exhibit a corresponding (here not shown) spline. In particular the apply plate **24** and the friction plates **27.1** and **27.2** exhibit inner teeth, which engage in a corresponding outer spline of the clutch hub **22,** and steel friction plates **25.1, 25.2** and **25.3** exhibit outer spline, which engage in a corresponding inner spline of the clutch housing **21**. The end plate **26** in this illustrative embodiment is formed material unitarily as one piece with the clutch hub **22**. It is however also conceivable that the end plate **26** exhibits a corresponding inner spline, which engages in the outer spline of the clutch hub **21**.

If then the individual components, namely apply plate **24**, steel plates **25.1, 25.2, 25.3**, friction plates **27.1, 27.1** and end plate **26** are pressed hard against each other with an appropriate press force, then they are in condition to transmit, by the rubbing of the respective corresponding contact surfaces against each other, a torque introduced by the clutch housing **21** onto the clutch hub **22** or as the case may be a torque introduced by the

clutch hub **22** onto the clutch housing **21**. In concrete terms this is realized thereby, that with the aid of the apply piston **28** a pressure device **28.4**, which in the Fig. 2a is shown in the withdrawn position, is pressed against the free contact surface of the apply plate **24**, so that this together with the remaining friction plates **25.1, 25.2, 25.3, 27.1** and **27.2** of the friction pack **23** are rigidly pressed in axial direction against the end plate **26** which is connected essentially rigidly with the clutch hub **22**.

The apply piston **28** in this illustrative embodiment is formed essentially ring shaped. On the outer circumference there is a projection in the shape of a cylinder outer surface, which forms the above-described apply ring **28.4**.

This apply piston **28** is, as has already been discussed above, supported axially slideably on an apply piston support device **32** and adapted for transmitting the pressure force onto the apply plate **24**. This apply piston support device **32** is likewise, with reference to the rotation axis R, formed essentially rotation symmetrical and is provided coaxial to the above-described components of the wet clutch **200**. It is comprised essentially of a ring shaped base plate **32.2** and a wall **32.1** in the shape of a hollow cylinder which connects form-fittingly to the outer circumference thereof. The apply piston support device **32** has therewith essentially the shape of a pot, which in the center of its floor (indicated by reference number **32.3**) exhibits an essentially circular shaped opening.

The apply piston **28** supports itself with a circular ring shaped floor surface **28.6** against the likewise circular ring shaped base or floor plate **32.2** of the apply piston support device **32**. The supported floor surface **28.6** of the apply piston **28** will hereafter be referred to as the outer floor surface **28.6**, the floor plate **32.2** of the apply piston support device **32** will hereafter be referred to as the piston support plate inner surface **32.2**.

The pot-shaped structure of the apply piston support device **32** is, as can be seen from Fig. 2a, provided oriented with it's open side directed in the direction of outer and clutch hubs **21, 22**. The cylinder shaped wall **32.1** of this pot shaped apply piston support device **32** is introduced in a recess

or groove **28.3** which is circular-ring shaped, formed into the apply piston **28,** and coaxial to the rotation axis R. The cylinder shaped edge surface of the apply piston support device forms in this manner a cylindrical contact surface **32.4**, against which the likewise essentially cylindrical contact surface **28.1** of the recess **28.3** of the apply piston **28** lies. Further, a cylindrical shaped outer surface **40.1** of the cylindrically shaped connecting device **40** forms a further support or contact surface **40.1** for the inner circumference surface **28.8** of the ring shaped apply piston **28**, so that the latter **28** is slideable in the axial direction against the contact surfaces **40.1, 32.4** of the connecting device **40** and the apply piston support device **32**. For explanation purposes it is mentioned, that the corresponding contact surfaces **40.1** and **28.8** or, as the case may be, **28.1** and **32.4**, do not lie immediately adjacent each other, but rather guide and sealing elements **38.2** and **38.3** are provided, which make possible a low friction movement and, beyond this, assume a sealing function.

It can further be seen from Fig. 2a how, in accordance with the state of the art, a balance piston **34** of the above-described type is constructed and arranged. The geometric shape of a balance piston **34** of this type corresponds basically to that of the above-described apply piston support device **32**. In particular the outer circumference an essentially circular ring shaped base plate **34.1** is attached to a cylindrically shaped wall **34.2**. The balance piston **34** therewith likewise has essentially the shape of a pot with a circular opening provided centrally in the floor.

The balance piston **34** is positioned, with reference to the apply piston **28,** in such a manner that one of the inner floor surfaces **28.7** of the floor of the apply piston **28**, which lies opposite to the outer floor surface **28.6,** plus balance piston **34** and the outer surface **40.1** of the connecting device **40** together encloses a space which will hereafter be referred to as the equalizing space **36**.

The outer surface **34.3** of the hollow cylinder wall **34.2** of the apply piston **34** and an inwardly facing cylindrical contact surface **28.2** formed by the recess of the circular ring shaped recess **38.3** formed in radial direction

R are provided adjacent to each other. Between these contact surfaces **28.2** and **34.4** there is in the above-described mode and manner provided a guide element/sealing element **38.1**, so that the apply piston is guided slideably supported by the balance piston **34** for sliding in the axial direction *ax*.

In the illustrative embodiment according to Fig. 2a there are thus essentially formed overall by the apply piston support device **32**, the apply piston **28**, the connecting device **40**, the balance piston **34** as well as the clutch hub **22** three spaces or spaces separated from each other, namely the apply piston space indicated with the reference number **35**, the equalizing space indicated with reference number **36** and the oil space indicated with reference number **31**. All these spaces - apply piston space **35**, balance piston space **36** and oil space **31** - are supplied with oil via the oil supply channels **39.1, 39.2** and **39.3** formed in the connecting device **40**. The function of the individual spaces **31, 35, 36** during actual operation will be discussed on the basis of Fig. 2b.

It is presumed that the clutch housing **21** is driven rotationally transmitting a torque. During operation of the apply piston **28** the steel core friction plates **25.1, 25.2,** and **25.3** come into frictional contact with the respective corresponding friction plates **24, 27.1, 27.2** and **26**, so that this torque is transmitted to the clutch hub **22**. Based thereon, the oil in the corresponding spaces of the apply piston space **35**, the balance piston space **36** and the oil space **31** is also brought into rotational movement. This rotational movement of the oil has the consequence that, on the basis of centrifugal force, it is thrown outward in radial direction r. This in turn has the consequence, that the pressure within these spaces **35, 36** and **31,** along their radial borders, increases. The qualitative pressure distribution in the radial direction in the apply piston space is represented in Fig. 2c, the corresponding pressure distribution in the equalizing space is shown in Fig. 2d.

It will be easy for the person of ordinary skill to understand, that on the basis of the larger radial outer surface area of the apply piston space **35**

larger pressure forces p_K occur in the piston space than in the equalizing space (p_A). For this reason the pressure force F_K of the apply piston **28** upon the apply plate **24** is steadily larger than the return-setting force F_A on the basis of the pressure in the equalizing space **36**. Known resetting spring systems, such as for example a here shown return spring device **33** in the equalizing space **36**, in general although sufficient for achieving a complete compensation, have a high constructional cost and a corresponding adjustment is in this case urgently needed.

In accordance with the invention it is thus provided, that the balance piston is not provided in the manner shown in Figs. 2a and 2b, but rather in the mode and manner shown in Figs. 1a and 1b.

Figs. 1a and 1b show a wet clutch **100** according to the invention. The wet clutch **100** according to the invention exhibits the below enumerated details in correspondence with the wet clutch **200** according to the state of the art, which is shown in Fig. 2a and 2b:

The basic elements of a wet clutch **100** of this type are, as described above in detailed, outer and clutch hubs **1, 2**, the friction pack **3,** the pressure and end plates referenced in this example with reference numbers **4** and **6**, the apply piston support device **12**, the apply piston **8** and the connecting device **20**.

Further, there is also provided in the inventive wet clutch **100** a balance piston **14**, which essentially exhibits the geometric shape of the balance piston **34** according to the state of the art. The balance piston **14** has an essentially ring shaped spring support **14.1** and a cylinder shaped wall **14.3** connected to the outer circumference of the spring support **14.1**. The inner surface of the spring support **14.1** forms a spring supporting surface **14.2** against which in essentially the axial direction *ax* a spring device **13** is supported. The spring device **13** is supported on the other side against the apply piston **8** and its apply piston support inner surface **8.7** of its piston support plate **8.8.**

In contrast to the illustrative embodiment according to the state of the art (Fig. 1) now the cylinder shaped wall **14.3** of the balance piston **14** is not

provided radially within the cylinder shaped wall **12.1** of the apply piston support device **12**, but rather in the axial direction between the clutch hub **2** and the cylinder shaped wall **12.1** of the apply piston support device **12**.

While now the apply piston **8** in the inventive embodiment is guided in the apply piston support device **12** and the connecting device **20** now as described before is slideable in the axial direction *ax* by means of the guide elements **18.2** and **18.3** against the contact surfaces **8.1** of the circular shaped recess **8.3** and the contact surface **12.1** as well as the cylindrical shaped outer surface of the connecting device **20**, now however the apply piston **8** guides the balance piston **14** now on the inner surface **14.4** of the cylinder shaped wall **14.3** thereof. As seal and guide aid there is again provided a guide element **18.1** of the above-described type.

As in the illustrative embodiment according to the state of the art, three spaces are enclosed by the apply piston support device **12**, the apply piston **8** and the connecting device **20** or as the case may be the apply piston **8**, the balance piston **14** and the connecting device **20** as well as the balance piston **14** and the clutch hub **2**, which in the following will be referred to as apply piston space **15**, equalizing space **16** and cooling oil space **11**.

Figs. 1c and 1d show, analogously to Figs. 2c and 2d, the pressure relationship in the apply piston space **15** or, as the case may be, in the equalizing space **16** during actuation of the wet clutch **100**.

As has already been discussed above, during rotating operation parabolic pressure profiles p_k p_A result in the radial direction r along the rotating surfaces **8.6, 8.7** of the apply piston **28** in the apply piston space **15** and in the equalizing space **16**. Fig. 1c) shows the parabolic pressure profile p_K (r) in the piston space **15**, which is represented in Fig. 16); Fig. 1d) shows the parabolic pressure profile p_A (r) in the equalizing space **16**, which is likewise represented in Fig. 1b).

The pressure profiles p_K in the apply piston space **15** according to Figs. 1a and 1b, on the basis of its design being identical with the apply piston space **35** according to Figs. 2a and 2b, identical to the pressure

profile p_K in the apply piston space **35** of the wet clutch **200** according to the state of the art.

In comparison thereto, the apply piston space **16** in the wet clutch **100** according to the invention is further expanded in the radial direction r. The oil wetted surface **8.7** of the apply piston **8** in the equalizing space **16** is thus, in comparison to the wetted surface **8.6** of the apply piston **8** in the apply piston space **15,** further extended or expanded in the radial direction. In this further expanded area the pressure p_A^* in the equalizing space **16** will thus further rise. Thus in this case even higher compensation forces F_A^* can occur than those pressure forces F_K, which result on the basis of the pressure increase p_K in the apply piston space **15**.

It has been found, that an arrangement of this type has further advantages. The engaging arrangement of clutch hub **2**, balance piston **14** and apply piston **8** supported on the apply piston support device **12** implicates, as already described above, the formation of a so-called oil space **11**. In this oil space there is situated likewise a certain amount of oil.

In an automatic transmission with wet clutch **100** it is necessary, for removal of the resulting frictional energy, to direct a part of this oil situated in the oil space **11** to the friction pack **3** in the form of an oil stream. Since the oil situated in the oil space **11** is thrown due to centrifugal force against the inner wall **2.1** of the clutch hub **2**, this is usefully guided via appropriate oil supply channels **9.1, 9.2, 9.3, 9.4**, which are situated in this inner wall **2.1** of the clutch hub **2**, to the individual friction plates **3, 4, 6**.

If the balance piston **14** is designed and provided in accordance with the invention, then the volume of the oil space **11** is substantially smaller than the oil space **31** according to the state of the art, as can be seen from Fig. 2. From this particular arrangement of the balance piston **14** alone there occurs a supplemental forced guidance of the oil, which supplementally supports the oil transport to the friction plates **4.6** of the friction pack **3**.

From the state of the art it is known to provide, for improvement of the oil transports to the friction plates **24, 25.1, 25.2, 25.3, 26, 27.1, 27.2** of

the friction pack **23,** on the apply piston **28** facing side of the clutch hub **22** a radially inwardly directed oil collecting or retaining ring **30**. An oil collecting ring of this type can be seen for example from the illustrative embodiment according to Figs. 2a) and 2b) representing the state of the art. Via this oil retaining ring **30** there is produced on the inner side **22.1** of the clutch hub **22** a fluid ring **37** of oil, which is supplied by oil flung out of the oil space **31**. Thereby the oil is comparatively efficiently guided through the above-described oil channels **29.1, 29.2, 29.3, 29.4** or the like in the clutch hub **22** to the friction plates **24, 25.1, 25.2, 25.3, 26, 27.1, 27.2** of the friction pack **23**. A higher oil volume is thereby detoured or bypassed to the clutch by overflowing the collecting ring **30**.

Preferably, the apply piston **8** facing side of the clutch hub **2** includes a radially (r) inwardly facing oil collecting ring **10.** At least one contact point, indicated in the figure with the reference symbol **A3,** to the balance piston **14** is provided at the inwardly facing oil collecting ring **10**, forming an oil space **11** between the balance piston **14**, clutch hub **2**, and oil collecting ring **10**. In this manner a forced flow is formed directly to the above-mentioned oil supply channels **9.1, 9.2, 9.3, 9.4** in the clutch hub **2**. An evasion by a greater oil volume is no longer possible.

For increasing the stiffness and therewith for improving the hydro-mechanical reaction ability of the total system it is envisioned that the balance piston **14**, as shown in the illustrative embodiment according to Fig. 1, includes at least one further contact point **A2** to the clutch hub **2**, which is provided on the spring support **14.1** of the balance piston **14**.

For guaranteeing a sufficient oil transport the hollow cylindrically shaped connecting device **20** exhibits a common oil supply **19.2** for the equalizing space **11** and the oil space **16**, while the apply piston is supplied via a separate oil supply **19.1**.

It is however possible, that separate oil supplies are provided for the equalizing space **16** and the oil space **19**.

Reference Number List

100	Wet clutch
1	Clutch housing
2	Clutch hub
2.1	Inner wall
3	Friction pack
4	Apply plate
6	End plate
8	Apply piston
8.1	Cylindrically shaped contact surface
8.2	Cylindrically shaped contact surface
8.3	Circular ring shaped recess
8.4	Pressure device
8.5	Cylindrically shaped contact surface
8.6	Piston support outer surface
8.7	Piston support inner surface
8.8	Piston support plate
9.1	Oil supply channel
9.2	Oil supply channel
9.3	Oil supply channel
9.4	Oil supply channel
10	Oil collecting ring
11	Oil space
12	Apply piston support device
12.1	Cylindrically shaped contact surface
12.7	Piston support inner surface

13	Spring device
14	Balance piston
14.1	Spring support
14.2	Spring support inner surface
14.3	Cylinder outer surface
14.4	Cylindrically shaped contact surface
15	Apply piston
16	Equalizing space
17	Oil ring
18.1	Guide element
18.2	Guide element
18.3	Guide element
19.1	Oil supply opening
19.2	Oil supply opening
20	Connecting device
200	Wet clutch
21	Clutch housing
22	Clutch hub
23	Friction pack
24	Apply plate
24a	Friction lining of the apply plate
25.1	Steel plate
25.2	Steel plate
25.3	Steel plate

26	End plate
26b	Friction lining of the end plate
27.1	Friction plate
27.2	Friction plate
27.1a	Friction lining
27.1b	Friction lining
27.2a	Friction lining
27.2b	Friction lining
28	Apply piston
28.1	Cylinder shaped contact surface
28.2	Cylinder shaped contact surface
28.3	Ring shaped recess
28.4	Pressure device
28.6	Outer base surface
28.7	Inner base surface
28.8	Inner circumference surface
29.1	Oil supply channel
29.2	Oil supply channel
29.3	Oil supply channel
29.4	Oil supply channel
30	Oil collecting ring
31	Oil space
32	Apply piston support device
32.1	Wall
32.2	Piston support plate inner surface
32.3	Piston support plate

32.4	Contact surface
33	Spring device
34	Balance piston
34.1	Base plate
34.2	Wall
34.3	Outer surface
35	Apply piston space
36	Equalizing space
37	Oil ring
38.1	Guide element
38.2	Guide element
38.3	Guide element
39.1	Oil supply opening
39.2	Oil supply opening
39.3	Oil supply opening
40	Connecting device
40.1	Contact surface
ax	Axial direction
r	Radius
R	Rotation axis
p_K	Pressure in the piston space
p_A	Pressure in the equalizing space
p_A^*	Pressure in equalizing space
F_K	Force on the basis of pressure in the piston space
F_A	Force on the basis of pressure in the equalizing space
F_A^*	Force on the basis of pressure in the equalizing space

A1	Contact point
A2	Contact point
A3	Contact point